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RAC1-EPA-2683

Contract No. 68-W6-0045

November 16, 2000

Mr. Ronald Jennings (HBT)
U. S. Environmental Protection Agency
One Congress Street, Suite 1100
Boston, Massachusetts 02114-2023

Subject: Transmittal of Draft Final Remedial Investigation Report
Raymark – Area III - Ferry Creek, OU3, Remedial Investigation/Feasibility Study
RAC I W.A. No. 002-RICO-01H3

Dear Mr. Jennings:

Enclosed are five copies (four bound, one unbound) of the Draft Final Area III Remedial Investigation for the Ferry Creek, OU3 study area. As instructed by you, I have also transmitted four copies of the report to the Connecticut Department of Environmental Protection (CTDEP), four copies of the report to the U.S. Army Corps of Engineers (ACOE), and one copy of the report to the National Oceanic and Atmospheric Administration (NOAA). In addition, three copies of the document will be delivered to the Raymark Advisory Committee (RAC) – one to Ms. Kathleen Conway, and two to the RAC internal library. One additional copy will be sent to the Stratford Public Library.

If you have any questions, please contact me.

Very truly yours,

Heather M. Ford

Heather M. Ford
Project Manager

PMO -

HMF:pmp

Enclosures – 2 volumes per copy

c: H. Horahan (EPA) w/o enc.
R. Curran (CTDEP) w/enc. (4)
L. Borachaner (ACOE) w/enc. (4)
K. Finkelstien (EPA) w/enc. (1)
Stratford Public Library (hand delivered) w/enc. (1)
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DRAFT FINAL
AREA III
REMEDIAL INVESTIGATION

VOLUME I OF II
TEXT, TABLES, AND FIGURES

RAYMARK-FERRY CREEK-OPERABLE UNIT 3
STRATFORD, CONNECTICUT

RESPONSE ACTION CONTRACT (RAC), REGION I

For
U.S. Environmental Protection Agency

By
Tetra Tech NUS, Inc.

EPA Contract No. 68-W6-0045
EPA Work Assignment No. 002-RICO-01H3
TtNUS Project No. N7491

November 2000

TETRA TECH NUS, INC.

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APPENDICES (VOLUME II)

1.0 INTRODUCTION

This source control Remedial Investigation (RI) Report defines the nature and extent of soil and sediment contamination within Area III resulting from past disposal practices at the Raymark Industries, Inc. Facility (Raymark Facility), located in Stratford, Connecticut (Figure 1-1). This report was prepared by Tetra Tech NUS, Inc. (TtNUS), for the U.S. Environmental Protection Agency (EPA) under RAC Work Assignment No. 002-RICO-01H3, Contract No. 68-W6-0045, to partially fulfill the requirements for Operable Unit No. 3 (OU3), Raymark - Ferry Creek. A Draft RI was developed in June 1998 for eight areas affected by Raymark soil-type waste. However, when EPA determined additional information was needed for some of these areas, a decision was made to recombine the areas into source control investigations, Area I, Area II, and Area III. Each of these three areas is comprised of subareas as described below. A groundwater investigation has not been conducted for Area III.

Area I, the northernmost portion of OU3, is comprised of Areas A-1, A-2, and A-3 (Figure 1-2). Area I is located just south of Interstate 95 and is bounded to the south by Broad Street. A final RI report for Area I was issued in October 1999. Area II is comprised of Areas B, C, and F. It's northern boundary is Broad Street, and it primarily includes wetlands and open water around lower Ferry Creek and its confluence with the Housatonic River (Area B), the wetlands south of the Housatonic Boat Club (Area C), and Selby Pond (Area F). The Draft RI for Area II was issued in March 2000.

Area III, the focus of this report, is the southernmost portion of OU3, that includes Areas D and E. Area D is the area surrounding the Beacon Point boat launch and Area E is the wetlands along Elm Street just west of Area D. Refer to Figure 1-2 for the locations of each Area.

This Area III RI Report was prepared in accordance with the *Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA, 1988). It is consistent with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986; and the National Oil and Hazardous

Substances Pollution Contingency Plan (NCP). This Area III RI is consistent with the State of Connecticut's applicable and relevant environmental laws and regulations.

Soils and sediments as discussed in this RI report for Areas D and E have been distinguished as according to the following definitions. Soils are defined as solid matrix samples from relatively dry areas located outside designated wetland boundaries and not associated with creeks, creek beds, or the Housatonic River. Wetland soils are defined as solid matrix samples collected from designated wetland boundaries. Sediments are defined as solid matrix samples collected from creeks, creek beds, or the Housatonic River.

1.1 Purpose of Report

This Area III RI Report documents the nature and extent of contamination, and associated public health and environmental risks. The overall objectives of this RI are to:

- Compile and evaluate all available data needed to characterize Area III conditions and to determine the nature and extent of contamination in the surface water, sediment, soil, and biota within Area III,
- Assess the risks to human health and the environment within Area III,
- Serve as the data resource for developing, screening, and evaluating a range of potential alternative remedial actions to address the contamination within the Area III. The RI also supports the Remedial Alternatives Screening and the Feasibility Study (FS).

1.2 Report Organization

This RI Report comprises two volumes. Volume I presents the text and discussion of investigation activities, results, interpretations, and references. Volume I also includes the tables and figures referenced in the text. Volume II presents the appendices. Appendix A contains the boring logs and sediment sample log sheets from the TtNUS sampling efforts; Appendix B is comprised of a disk, which contains all the analytical data used to produce this

RI report; Appendix C is the Hydraulic Assessment prepared by the U.S. Army Corps of Engineers (USACOE); Appendix D is backup tables and calculations for the ecological risk evaluation, the Ecological Risk Assessment prepared by the National Oceanic and Atmospheric Administration (NOAA), and the Ecological Risk Assessment supplements prepared by Science Applications International Corporation (SAIC). Appendix E contains the supplemental Evaluation of Contaminant Fate and Transport; and Appendix F is the backup tables and calculations for the Human Health Risk Assessment.

This RI Report is organized as follows:

- Section 1.0, Introduction, discusses the purpose and scope of the RI, summarizes the background and history of the Raymark Facility, and describes Area III.

- Section 2.0, Study Area Investigations, presents a summary of the field investigation activities conducted both within and outside Area III.

- Section 3.0, Physical Characteristics of the Study Area, presents descriptions of surface features and land uses, geology, hydrogeology, surface water hydrology, and meteorology.

- Section 4.0, Nature and Extent of Contamination, discusses the potential sources, contaminant presence, and contaminant distribution within the biota, the soils, surface water, and sediment in Area III.

- Section 5.0, Contaminant Fate and Transport, presents an interpretation of potential contaminant migration pathways and transport mechanisms.

- Section 6.0, Baseline Human Health Risk Evaluation, includes identification of human receptors and exposure pathways, selection of contaminants of concern (COCs), and a discussion of the human health effects associated with the COCs. The results of the evaluation are used to characterize human health risk.

- Section 7.0, Ecological Evaluation, presents a summary of the environmental setting and identifies areas of potential ecological concern. The results are used to characterize ecological risk.

- Section 8.0, Summary and Conclusions, summarizes the nature and extent of contamination, the fate and transport of contaminates, and the risks to human health and the environment associated with Area III.

1.3 Study Area Background

This section summarizes the history of the Raymark Facility, describes the study area, and identifies other areas associated with the Raymark Facility. Refer to *the OU1 Final Remedial Investigation Report* (HNUS, 1995) for further details on facility operating history, environmental activities, permits, and compliance history.

1.3.1 History of the Raymark Facility

The Raymark Facility, formerly named Raybestos - Manhattan Company, was located at 75 East Main Street in Stratford, Fairfield County, Connecticut at latitude 41°12′02.5″N and longitude 73°07′14.0″W (see Figure 1-1). The Raymark Facility operated from 1919 until 1989, when the plant was shut down and permanently closed. The manufacturing of these products generated waste. The facility was demolished and a cap was placed over the contaminated areas on the property in 1996 and 1997. Based on Stratford tax map information, the facility occupied 33.4 acres and manufactured friction materials containing asbestos and non-asbestos components, metals, phenol-formaldehyde resins, and various adhesives. Primary products were gasket material, sheet packing, and friction materials including clutch facings, transmission plates, and brake linings. As a result of these activities, soils at the facility became contaminated primarily with asbestos, lead, and polychlorinated biphenyl compounds (PCBs).

Between 1919 and 1984, low-lying portions of the Raymark Facility were filled with manufacturing waste materials from various plant operations. The filling of those areas occurred over the life of the facility operations, and progressed essentially from north to south, across the Raymark Facility. New buildings and parking areas were constructed over these filled areas as the manufacturing facility expanded.

The Raymark Facility was underlain by an extensive drainage system network. This network collected water and wastes from the manufacturing operations and diverted it into the facility drainage system. The system also collected stormwater runoff. These liquids were transported through the drainage system network, mixed with lagoon wastewaters, and discharged to Ferry Creek.

During peak operations at the Raymark Facility, approximately 2 million gallons of water were used for plant processes each day. Municipal water was used for both contact and non-contact cooling water. To supplement this source, Raymark installed an additional on-site supply well. The well, located in the northeastern corner of the facility, was used for non-contact cooling water. Facility water was recirculated, with some percentage reinjected into the on-site well, the remaining water and municipal water were discharged through the facility drainage system. Wastewater from facility operations was collected and discharged to a series of four settling lagoons located in the southwestern corner of the facility, and along the southern property boundary near Longbrook Avenue and the Barnum Avenue Cutoff. The wastewater consisted of wastewater from the acid treatment plant, wet dust collection, paper-making processes; non-contact cooling water, and wastewater from solvent recovery plant operations. The lagoons also received stormwater drainage and surface water runoff.

Solids were allowed to settle in Lagoon Nos. 1, 2, and 3 prior to discharge of clarified wastewater and unsettled solids to Lagoon No. 4, that in turn discharged directly into Ferry Creek. Discharge of wastewater to Lagoon Nos. 1, 2, and 3 ceased in 1984. These lagoons were closed in December 1992 and January 1993. After 1984, only stormwater drainage was discharged from the facility (through Lagoon No. 4). During the fall of 1994, stormwater drainage that exited the Raymark Facility through Lagoon No. 4 was diverted around this lagoon and connected directly to the storm sewer, which ultimately discharges to Ferry Creek. Lagoon No. 4 was closed in early 1995.

During the operation of the lagoons, the settled material was periodically removed by dredging. During the facility's 70 years of operation, it was common practice to dispose of both this dredged lagoon waste and other manufacturing waste as "fill" material (referred to as "Raymark soil-waste/fill" in this RI) both at the Raymark Facility and at various locations in Stratford. Several of these locations that received Raymark soil-waste/fill are included within Area III (Figure 1-2).

A number of the off-the-facility "locations," where Raymark soil-waste/fill was disposed, were contaminated with levels of asbestos, lead, and PCBs that posed a threat to public health. To abate the potential health threat to residences, residential properties were remediated under EPA CERCLA time-critical removal actions during 1993 to 1996. The excavated material from these residential locations was stored and ultimately placed under the cap at the Raymark Facility. Waste from one municipal property, Wooster Middle School, was also excavated, stored, and ultimately placed under the cap at the Raymark Facility.

1.3.2 Study Area Description and Setting

The study area for this Area III RI includes a public boat launch area, a dry dock area, and the surrounding wetlands impacted by Raymark Facility waste (north and south of the boat launch) near Beacon Point Road (Area D), and a wetland area along Elm Street adjacent to and south of 1260 Elm Street (Area E). Originally, the OU3 area was defined as the commercial properties (Morgan Francis, Spada, and the Housatonic Boat Club) where Raymark soil-waste/fill was known to have been deposited. The OU3 area was expanded to include Areas D and E based on analytical results of surface water and sediment sampling (Figure 1-2).

Because more information was needed on certain areas of these parcels, EPA decided to separate the OU3 areas into three study areas. This RI contains information on Area III, which includes Areas D and E. These locations are downgradient of the former Raymark Facility and may have been affected by wastewater discharge, stormwater drainage, surface water runoff, manufacturing waste direct deposition, and groundwater contaminant migration. The name designations used for locations and properties in this report are those that have become convention for the study area, as established by EPA. The Area III study area is comprised of the following properties:

- **Area D (Beacon Point Area)** is located to the south and adjacent to Area C. It is bounded by Beacon Point Road and Tide Harbours Condominium Complex to the west, the Housatonic River to the south and east, and the Harbour Woods Condominium Complex Boat Dock to the north. It encompasses undeveloped wetlands that are tidally influenced by the Housatonic River, a public boat launch area that EPA refers to as the Birdseye Boat Launch, and a dry dock area that EPA refers to as the Beacon Point Dry Dock. Area D covers approximately 20 acres, including approximately 3 acres of wetlands, 9 acres of open water, and the remaining 8 acres of man-made features (the public boat launch, the dry dock area, and an erosion barrier along the shoreline). Samples for this area include soils, sediment, surface water, and biota.

- **Area E (Elm Street Wetlands)** is a 30-foot-wide strip located approximately 600 feet west of the southern portion of Area D. It is bounded by residential properties along Elm Street to the west and north, the Stratford wastewater treatment plant to the east, and the remaining wetland area referred to by EPA as the Elm Street wetland. Area E covers approximately 1 acre, which is entirely wetland. Samples for this area include soil, sediment, and surface water.

1.3.3 Other On-Going Activities

Activities undertaken in the vicinity of the study area that are related to the investigations conducted to support this RI include:

- ***OU1* - Cleanup of the source at the OU1-Raymark Facility is complete**. EPA completed a Remedial Investigation and Feasibility Study for controlling sources of waste at the 33-acre Raymark Facility in 1995 describing the type and location of wastes, the risks posed by those wastes, and discussed possible cleanup solutions. After receiving public comments, EPA decided to consolidate Raymark wastes excavated from the residential areas and the Wooster Middle School at the OU1-Raymark Facility and cap the property. EPA documented this decision in a ROD in June 1995. Once the approach was selected, EPA began the actual cleanup. This included demolition of 15 acres of buildings, consolidation of over 100,000 cubic yards of off-site Raymark waste and the placement of an impermeable cap with a soil gas collection system over the entire property. Solvents, called dense non-aqueous phase liquids (DNAPLs), in the underlying groundwater and gases beneath the cap are treated at facilities onsite. Final construction was completed in November 1997. The site is now operated and maintained by the CT DEP.

- *OU2* - **Groundwater Remedial Investigation Activities** - The Remedial Investigation/Feasibility Study is in progress. This groundwater investigation focuses on a 500-acre study area largely downgradient of the OU1-Raymark Facility that has become contaminated with volatile organic compounds (VOCs) and metals, presumably from the activities conducted on the property. The study area includes businesses that have handled or continue to handle hazardous materials, but investigations are focused on groundwater contaminants that appear to be attributable to the OU1-Raymark Facility. Currently, groundwater in this operable unit is not used as a drinking water supply. In some portions of the study area, contaminants in the groundwater appear to be volatilizing, or discharging to surface water, which may pose a threat to human health or the environment.

  EPA intends to issue a Final Remedial Investigation in 2001 describing contamination and potential health risks for this operable unit. EPA also plans to release a Feasibility Study, analyzing potential cleanup solutions for the area, in 2001/2002. Possible remediation alternatives include no action; limited pumping and treating; and in-situ groundwater treatment.

- *OU4* - **Raybestos Ballfield Remedial Investigation Activities** – The Remedial Investigation is complete, and the Feasibility Study is in progress. This area, a former ball field and park, was built using waste fill from the Raymark Facility (see Figure 1-2). In 1992, EPA fenced this area, sampled and removed drummed wastes, and placed a soil cover over contamination at the site. EPA released a final Remedial Investigation in June 1999 that described the nature and extent of contamination at this area.

  EPA plans to release a Feasibility Study in 2001. EPA will select and document its chosen cleanup solution once the Feasibility Study has been reviewed by state and local officials and the public. Cleanup options currently being evaluated for this operable unit include capping existing wastes in place; excavation of all wastes for off-site disposal; treatment of wastes; consolidation of up to 155,000 cubic yards of Raymark wastes from other operable units with existing wastes at OU4 (affording possible reuse of the property); and consolidation of up to 422,000 cubic yards of Raymark wastes from other operable units with existing wastes at OU4 (possibly preventing reuse of the property).

- ***OU5* - Shore Road Activities** - This area is a roughly 4-acre section of Shore Road near the Housatonic Boat Club and the former Shakespeare Theater that borders on the Housatonic River (see Figure 1-2). As a temporary measure, contamination in this area was covered with an interim plastic fabric barrier and wood chips by the CT DEP in 1993. The area was sampled extensively in 1998/1999 and high levels of contamination were present in the surface soils. As the area is contaminated, and because the plastic barrier was beginning to wear and the wood chips were beginning to erode, EPA accelerated cleanup. An Engineering Evaluation/Cost Analysis (EE/CA), completed in June, 1999, presented cleanup alternatives. In September 1999, following the public comment period, EPA released an Action Memorandum documenting its cleanup strategy.

The Action Memorandum stated that EPA will test waste stabilization techniques that could minimize the release of waste dust during the excavation of Shore Road wastes. It also stated that wastes from the Shore Road Study Area will be deposited in a temporary storage facility within Stratford. During the public comment period on the EE/CA, EPA discussed the Raybestos Memorial Ballfield and/or the Contract Plating Company property as potential temporary storage facilities for the approximately 35,000 cubic yards of soil. Based on the negative public support for waste storage at either location, EPA decided to suspend final remedial action at the study area. Instead an interim removal action was planned. This action included limited temporary capping of contaminated hot spots, relocation of utilities, repair of existing stone riprap revetment, restoration of the western shoulder and embankment cover along Shore Road, and placement of sheet piling to prevent erosion of materials.

EPA began these excavation and cleanup activities in November, 1999 and completed the interim action in July, 2000. As EPA completes investigations for other Raymark operable units in Stratford, it will decide on a final remedy for this study area that is compatible with the other operable units.

- ***OU6* - Commercial Properties Activities** - A Remedial Investigation is in progress. This 48-acre area encompasses approximately 22 commercial properties, many along Ferry Creek that received Raymark wastes as fill (see Figure 1-2). Additional properties may be added to the list in the future. These areas are being investigated separately by EPA because commercial landowners face a unique set of issues related to site cleanups under Superfund.

  The type and extent of contamination at these sites will be described in the Remedial Investigation scheduled for release in 2001. A Feasibility Study examining cleanup options for this area is also planned for 2001. The particular cleanup approaches for these properties will vary by property depending on the extent of contamination and the risks to human health and the environment at each property. Cleanup options may include addressing portions of each property containing Raymark wastes through excavation, consolidation, treatment, or capping.

- ***OU7 Activities/OU3 Area II*** - A Draft Final Remedial Investigation has been completed. This area includes approximately 36 acres of wetlands roughly in the center of the Raymark Industries, Inc. Superfund Site (see Figure 1-2). Interim measures for this operable unit have included placement of signs at Selby Pond warning people not to eat eels caught in the pond, and placement of signs warning of contamination within the wetlands. EPA has also excavated contamination from a residential area abutting Selby Pond. EPA sampled these water bodies that make up OU7 in which Raymark wastes have been deposited through dumping and erosion.

  A Feasibility Study for these areas is planned to be released in 2001. This area contains approximately 315,000 cubic yards of contaminated soils and fill and approximately 50,000 cubic yards of contaminated sediment. Possible cleanup approaches for this operable unit include capping in place, treatment, excavation, and dredging with wetland restoration.

- ***OU8 Activities/OU3 Area III*** - A Draft Final Remedial Investigation has been completed. This 21-acre area is the southernmost operable unit of the Raymark Industries, Inc. Superfund site, and includes the Beacon Point boat launch area and wetlands along Elm Street (see Figure 1-2). EPA removed contaminated soil from several acres of an Elm

Street residential property within this area in 1994. This soil was consolidated and capped at the Raymark Facility. EPA recently completed sampling for these areas.

The Feasibility Study for these areas is also anticipated in 2001. This area contains approximately 200,000 cubic yards of contaminated soils and fill, and 18,000 cubic yards of sediment. Possible cleanup approaches include capping in place, treatment, excavation, and dredging with wetland restoration.

1.3.4 Previous Investigations

A substantial number of field investigations relating to soil, sediment, surface water, biota, and groundwater have been conducted at the Raymark Facility and its environs. A discussion of investigations that are pertinent to the study area identified in this RI is included in Section 2.0.

2.0 STUDY AREA INVESTIGATIONS

This section presents a brief description of each investigation performed to characterize the impacts to wetlands and other properties resulting from past disposal of Raymark soil-waste/fill. Previous investigations relevant to Area III are presented in Section 2.1; and investigations relevant to the entire OU3 study area are summarized on Table 2-1. Information collected from these investigations was used to meet the Remedial Investigation objectives presented in Section 1.1.

Additional investigations performed at the Raymark Facility to characterize the on-site materials and facility setting are summarized in the *Final RCRA Facility Investigation Report, Raymark Industries, Inc.* (ELI, 1995) and the *Final Remedial Investigation Report, Raymark Industries, Inc. Facility* (HNUS, 1995). Further evaluation of groundwater contamination beneath and migrating downgradient of the Raymark Facility is currently being conducted.

Investigation of properties potentially affected by Raymark soil-waste/fill have been conducted since 1992 (see Table 2-1 and sections below). The information is presented below in chronological order. Many dates overlap because contractors were hired by a variety of entities (EPA, State of Connecticut, and the Army Corps of Engineers) to perform specific tasks. In addition, many investigations were conducted on properties both within and outside Area III. These investigations are included in this section. There have been investigations conducted for other Raymark investigations that do not impact Area III. These investigations have not been included.

2.1 Surface Water and Sediment Investigations (1992 - 1994)

Surface water and sediment sampling was conducted at the Raymark Facility and environs by EPA, its contractors, and the various contractors hired by Raymark Industries Inc., from 1992 through 1994 in order to determine whether site contaminants were migrating off the property. The sampling assessed a series of four lagoons located at the Raymark Facility in the southwestern corner and along the southern property boundary near Longbrook Avenue and the Barnum Avenue Cutoff. These lagoons, frequently referred to as settling basins or ponds, received stormwater drainage, surface water runoff, and wastewater from various on-site operations. Solids were allowed to settle in Lagoon Nos. 1, 2, and 3 prior to discharge of clarified wastewater and unsettled solids into Lagoon No. 4, which discharged into a culverted tributary that directly discharged into Ferry Creek. Ferry Creek ultimately discharges to the Housatonic River that includes the Area D wetlands.

2.1.1 Sediment at Raymark Facility and along Ferry Creek Housatonic River (1992 - 1995)

In 1992, sediment samples were collected as part of an EPA Site Inspection for Raymark Industries. Fifteen samples were collected along Ferry Creek and the Housatonic River. Samples were submitted to EPA-approved laboratories for analysis of volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), PCBs, metals, cyanide, dioxins/furans, and asbestos. Numerous site-related organic and inorganic contaminants were detected at elevated levels. The sampling locations and analytical results are summarized in Weston's Final Site Inspection Report (Weston, 1993).

2.1.2 Surface Water at Raymark Facility (1993)

Five surface water samples were collected in July 1993 to characterize both the quantity and quality of drainage discharges into and out of Lagoon No. 4. After installation of the surface stormwater drainage diversion system around Lagoon No. 4, the outlet to this lagoon (Station No. 5) was resampled in October 1993. Samples were submitted for laboratory analysis of VOCs, SVOCs, PCBs, metals, cyanide, sulfide, chlorinated herbicides, organophosporous pesticides, dioxin/furan, and asbestos (ELI, 1994). These sampling rounds confirmed that the site had discharged contaminated materials/water into Ferry Creek. Results from subsequent sampling indicated that similar contaminants were detected both on site and in the creek sediments (HNUS, 1994/1995 sediment and surface water sampling results). Ferry Creek ultimately discharges to the Housatonic River which includes the Area D wetlands.

2.2 <u>Soil Sampling (1993)</u>

Numerous properties were sampled around Stratford to identify the extent of soil contamination resulting from disposal of Raymark soil-waste/fill. Residential properties were sampled and evaluated, and waste was excavated when appropriate. Commercial and wetland properties were sampled, but no cleanup has occurred to date. The sample results from the commercial and wetland properties in and around Areas D and E are included in this RI.

2.3 Phase I Remedial Investigation (1993 - 1995)

The Phase I Remedial Investigation was conducted from 1993 through 1995. This investigation consisted of treatability studies and field work. This investigation was conducted by HNUS under EPA Contract No. 68-W8-0117, ARCS Work Assignment No. 42-1LH3. The activities conducted as part of the field investigation included soil boring and sampling program, salinity survey, ground penetration radar (GPR) survey, and topographic survey. The investigation also included advancing soil borings for groundwater monitoring well installations. Pertinent activities conducted as part of the environmental sampling program included four rounds of surface water and sediment sampling. These activities are described below.

2.3.1 Surface Water and Sediment Sampling (1994 - 1995)

Four rounds of surface water and sediment sampling were conducted at selected locations to evaluate potential contaminant migration from the Raymark Facility. In the course of the four sampling rounds, 140 locations were sampled from streams, ponds, wet areas, and leachate outbreaks identified by EPA from within the original study area. Based on sampling results and discussions with EPA, the study area was further refined; 96 of these 140 sampling locations are located within the limits of the OU3 study area as currently defined (Areas A-1, A-2, A-3, B, C, D, E, and F). Surface water samples were collected and submitted to EPA-approved laboratories for analysis of target compound list (TCL) VOCs, TCL SVOCs, TCL pesticides/PCBs, and target analyte list (TAL) metals. Field measurements included pH, temperature, specific conductivity, dissolved oxygen, and salinity. Sediment samples were submitted to EPA-approved laboratories for analysis of TCL VOCs, TCL SVOCs, TCL pesticides/PCBs, TAL metals, asbestos, dioxin/furans, total organic carbon (TOC), and grain size. In the fourth sampling round, some sediment samples were also submitted for acid volatile sulfide/simultaneously extractable metals (AVS/SEM) analysis.

This work provided information on the extent of contamination. The information was used to define the Area III study area.

2.4 Comprehensive Site Investigation Sampling Program (1994 - 1995)

Using data developed by others, Comprehensive Site Investigation (CSI) reports were prepared in 1994 and 1995 for properties under investigation as part of the Stratford Superfund Sites program. The purpose of the CSIs was to determine the extent and magnitude of lead, PCB, and asbestos contamination associated with Raymark soil-waste/fill disposal in surface and subsurface soils. The CSI reports were designed to provide site-specific data necessary to proceed with the Stratford Superfund Sites Removal Action Program. The information contained in the reports was based on the subsurface samples collected during the vertical sampling program (1993).

Sample locations were selected based on a systematic grid approach for each property investigated. Grid intersections were set at 25-foot intervals and sampling was conducted at each grid intersection. Surface soil samples were collected from depths of 0 to 12 inches bgs using a stainless steel trowel. Subsurface soil samples were obtained from depths of 1 to 12 feet bgs using a hand-operated Geoprobe® slide-hammer piston rod apparatus advanced hydraulically using a Terraprobe® truck-mounted unit. Soil samples from each boring were visually classified and logged. Constituents of all soils were characterized using the Burmister soil classification ranges, and soil color was described using Munsell color charts. Samples were composited from 1-foot intervals and screened at the on-site laboratory for asbestos, lead, and PCBs. Approximately 10 percent of the samples were submitted for confirmatory analysis at an off-site laboratory.

Site-specific data for numerous properties have been generated through the CSI program. CSIs have been conducted on properties adjacent or closely proximate to portions of Areas D and E properties. Final CSI Reports for these applicable properties were completed in 1995, and report sections relevant to OU3 were presented in *the Final Technical Memorandum, Compilation of Existing Data, RI/FS, Raymark - Ferry Creek* (B&RE, 1997). This information served as a resource for additional data collection and in data interpretation for this RI Report.

2.5 Removal Actions Post-Excavation Program (1994 - 1996)

Specific site property excavations were performed based on the results of the CSI sampling program discussed in Section 2.5. Upon completion of the excavations, samples were collected to ensure that the contaminated materials were removed. Removal action soil sample locations were selected based on a systematic grid approach for each property excavated. Grid intersections were set at 15-foot intervals; samples were collected at depths of 0 to 3 inches from each exposed wall, base, and perimeter of an excavated grid using a pre-cleaned iron shovel or hand trowel. Samples were composited from each exposed surface and screened at the on-site laboratory for asbestos, lead, and PCBs. Approximately 10 percent of the samples were submitted for confirmatory analysis at an off-site laboratory. Once the contaminated materials were removed, the areas were backfilled with clean materials and seeded.

Post-Excavation Record Plans were prepared for these properties. As stated in the *Final Technical Memorandum, Compilation of Existing Data, RI/FS, Raymark - Ferry Creek* (B&RE, 1997), data and information from Post-Excavation Record Plans adjacent or closely proximate to portions of Areas D and E were completed between 1994 and 1996. The Post-Excavation Record Plans documented the soil removal action clean-up activities conducted at each property and showed that the established clean-up criteria had been achieved.

2.6 Ecological Risk Assessment (1996 - 1999)

An Ecological Risk Assessment report was prepared for EPA Region I by NOAA and its contractor (NOAA, 1998). This assessment addressed the risks to ecological receptors posed by contaminants present in Ferry Creek, portions of the Housatonic River, and associated wetlands. A Phase III Ecological Risk Assessment was completed by SAIC (SAIC 1999) to assess the ecological impacts of contaminants on wetland, intertidal, marsh, and freshwater habitats of Areas D and E (as well as Areas B, C, and F). The information from these reports is evaluated and is summarized in Section 7.0. Both reports are presented in their entirety in Appendix D.

2.7 Phase II Site Investigation (1997)

A review of all the data from 1992 through 1996 identified data gaps. These data gaps indicated the need to collect additional field data to finalize the RI and support the FS for the OU3 study area. Field investigations and sample collection were conducted by HNUS during July and August 1997. Field activities included advancing soil borings and collecting soil samples, and collecting surficial soil and sediment samples. These activities are described in the sections below.

2.7.1 Soil Borings and Soil Sampling

Additional soil borings were collected to further determine the nature and extent of the contamination.

Soil borings were advanced, and surficial and subsurface soils were collected in Area D. Individual boring locations were selected based on previously identified data gaps, and as a result of meetings between TtNUS, EPA, and CT DEP. Soil borings were advanced to depths of 16 feet using hollow-stem auger methods. The intent was to advance the boring until "natural" soil was encountered. At the direction of EPA, no borings were advanced to depths greater than 16 feet.

Continuous split-barrel sampling was conducted throughout the advancement of each boring, and soil samples were field screened using a portable photoionization detector (PID) or flame ionization detector (FID). Based on PID or FID field screening results, selected samples were sent for laboratory analysis of VOCs. Soils from each sampled interval were sent to the Connecticut Department of Health (CT DOH) laboratory for analysis of asbestos. Soil samples were also sent to an off-site laboratory for screening of lead and copper using x-ray fluorescence (XRF). Based on the XRF screening results, an average of two samples were selected from each borehole for analysis at EPA-approved laboratories. Analyses included TCL VOCs, TCL SVOCs, TAL metals, dioxin/furans, and/or TCL pesticides/PCBs (plus Aroclor 1262 and 1268). Selected soil samples were also analyzed for Synthetic Precipitation Leaching Procedure (SPLP) metals, based on the amount of soil recovered from the sampled interval, direction from EPA in the field, and the XRF field screening results.

2.7.2 Sediment Sampling

Additional sediment samples were collected to further determine the nature and extent of contamination within the study area. Samples were collected from stream channels, wetland areas, and estuarine shore locations to evaluate the nature and extent of contamination, and the physical/geotechnical properties of the sediment. Sediment samples were collected in Areas D and E from depths of up to 6 feet bgs.

Samples submitted for chemical analysis were collected using or grab sampling techniques such as a piston-core sampler or hand auger. Sediment samples were field screened using a portable PID or FID. Selected samples were submitted to EPA-approved laboratories for analysis of TCL VOCs, TCL SVOCs, TCL pesticides/PCBs (plus Aroclor 1262 and 1268), TAL metals, dioxins/furans, TOC, and/or grain size. Selected samples were also submitted to the CT DOH laboratory for analysis of asbestos. An additional 10 percent of the pesticide/PCB samples were also analyzed for PCB homologues and PCB congeners. Selection of samples for analysis of TCL VOCs was determined based on PID or FID screening results.

3.0 PHYSICAL CHARACTERISTICS OF THE STUDY AREA

This section summarizes the physical characteristics of the study area and region in which Area III is situated. The surface features and land uses are described in Section 3.1. Discussions of related geology, hydrogeology, surface water hydrology, and meteorology are presented in Sections 3.2 through 3.5, respectively.

3.1 Surface Features and Land Use

Area III is part of the Housatonic River Basin, a tidally influenced drainage system. Area III covers approximately 21 acres, including approximately 13 acres of wetlands and/or open water. A description of the study area is included in Section 1.3.2.

The topography of Area III is relatively flat, with gentle slopes to several wetlands and open water of the Housatonic River. Man-made debris such as slag, concrete, and asphalt have been used as an erosion-barrier or riprap along the shoreline of the southern portion of the Beacon Point Area (dry dock). Discharge from the POTW drains across the Beacon Point Area via a stone riprap swale leading to the Housatonic River. Based on a review of USGS topographic maps, the majority of the study area lies at topographic elevations below 10 feet National Geodetic Vertical Datum (NGVD) 1929.

Area III is located within the 100-year floodplain, as observed from Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps for Stratford, Connecticut (FEMA, 1992), and as presented in the U.S. Army Corps of Engineer's Hydrologic Evaluation of the study area. The Hydraulic Evaluation is included in Appendix C. The 100-year frequency base flood elevation is 10.1 feet NGVD; the 10-year frequency flood elevation is 8.5 feet NGVD (USACE, 1998).

The Housatonic River is used for recreational fishing, shellfishing, and boating. The mouth of the Housatonic River is considered to be a recreational fishery and a potential source of human food-chain organisms. Coastal waterways are assumed to support various recreational activities, as well as recreational and commercial fishing. The lower Housatonic River, near the mouth of Ferry Creek, contains important commercial seedbeds for oyster cultivation.

Black-crowned night herons and red-winged blackbird have been observed around Area D. Also geese, swans, and other shore birds are routinely fed by citizens in Area D. State or federally listed threatened species reported to exist in the vicinity of Area III include the Atlantic sturgeon, and occasional transient bald eagles and peregrine falcons (NOAA, 1998; CT DEP, 1997; US DOI, 1997). No information on threatened species are available for Area E.

The principal industries within the Stratford community include manufacturing of aircraft, air conditioning, chemicals, plastic, paper, rubber goods, electrical and machine parts, and toys. The Stratford Town Clerk reported the latest (September, 1999) estimate for the population of the Town of Stratford as 47,230 people within the 19.9 square miles (12,736 acres) of the town. This is a decrease from the 1990 census when the population was listed as 49,389.

3.2 Geology

This section provides a brief overview of the geology of the region and Area III. The description of both the regional and Area III geology includes a general discussion of soils (natural deposits and artificial fill deposits) encountered in on-site borings, with an emphasis on surficial soils (thickness of fill map). Because no bedrock borings have been advanced in Areas D or E only a regional bedrock description will be provided (Section 3.2.1.2). For purposes of this report, fill is included within the category of a soil. The definitions used in this section include:

Glacial till, deposited by glacier ice, is variable in thickness, forming a discontinuous mantle over bedrock. The till consists of a non-stratified, poorly sorted mixture of coarse (pebbles/cobbles/boulders) and fine (sand/silt/clay) fractions, with the coarse fraction generally not exceeding 20 percent.

Ice-contact stratified drift includes sand, gravel, silt, and clay, frequently poorly sorted with abrupt changes in grain size. These deposits were formed during glaciation in streams and local ephemeral lakes in close relation to melting glacier ice, and often grade into outwash sediments.

Glacial outwash deposits are predominant in the stream valleys, and consist of highly stratified sand, silty sand, and gravelly sand. Beds are not persistent, and individual lenses attain thicknesses of tens of feet, and thin out or are truncated over short distances. Glacio-fluvial outwash units in the vicinity of the study area generally consist of sands with up to 50 percent gravel, grading up-valley (northward).

Swamp and marsh deposits are present in lowlands and in proximity to the Housatonic River. Tidal marshes are also present in this area. Swamp and marsh deposits consist of silt, sand, and clay-sized particles interbedded with organic fragments and peat deposits. The oldest marshes in the western coastal area of Connecticut (2,000 to 4,000 years old) have peat deposits of approximately 10 feet.

3.2.1 Regional Geology

The discussion of the regional geology is based on data collected during previous subsurface investigations and is also summarized in the *Final Remedial Investigation Report, Raymark Industries, Inc. Facility* (HNUS, 1995). Discussion of the regional geology is divided into two subsections: overburden and bedrock. The overburden is defined as unconsolidated deposits of sand, silt, gravel, clay, and peat. Bedrock consists of metamorphic rocks that are mainly schist and gneiss, overlain by overburden deposits.

3.2.1.1 Regional Geology

The State of Connecticut has been covered by glacial ice at least twice in geologic time. During the last retreat, glaciers deposited a thin mantle of till overlying bedrock. Glacio-fluvial outwash deposits formed thicker, highly stratified sequences of silty sand to gravelly sand that overlaid the till and filled bedrock valleys. Windblown sand and silt were also deposited on valley floors, however, these deposits are indistinguishable from present day organic topsoil deposits.

Area III is generally located in the Stratford outwash plain, on the western Housatonic River valley floor. Natural overburden deposits in the vicinity of Stratford consist of glacial deposits (outwash sediments, ice-contact stratified drift, and till) and recent swamp and marsh deposits (Flint, 1968).

3.2.1.2 Regional Bedrock Geology

Area III is located in the Connecticut Valley Synclinorium of Connecticut's Western Uplands, according to the "Bedrock Geological Map of Connecticut" (CT GNHS, 1985). The regional bedrock setting consists of a series of meta-sedimentary and meta-volcanic rocks of the Early and Middle Paleozoic Era, generally foliated, with foliation trending northeast-southwest, in a large syncline. These rocks are mainly schists, gneisses, and granites. The sequence was tightly folded and subjected to progressive regional metamorphism, ranging from chlorite to kyanite grade. A high angle fault is mapped approximately 1 mile to the southeast of the study area, across the Housatonic River, generally trending southwest to northeast (CT GNHS, 1985). The implication of this fault and any related splay faulting to local geology and contaminant transport was not evaluated. Bedrock does not outcrop (occur at the surface) within Area III.

3.2.2 Site Geology

The overburden geology of Area III is based on overburden data collected during soil boring activities conducted during several previous investigations as summarized in Section 2.0. No bedrock borings have been advanced in Area III, so a discussion of study area bedrock geology is not provided.

The surficial deposits that occur at, and within, the shallow subsurface of Area III are mapped as Stratford outwash sediments, fill deposits, and swamp/marsh deposits (Flint, 1968). Based on borings advanced in or near Area III, the surficial and overburden deposits are characterized primarily by a variety of locally derived glacial outwash deposits and ice contact deposits, alluvial deposits, swamp and marsh deposits, and fill materials. Glacial till may be present locally, but is discontinuous. Overburden consists of a complex sequence of alluvial and outwash deposits (sand and gravel) ranging from silty sands to coarse gravels. Peat/organic silt deposits in Area III frequently underlie fill materials.

An estimated thickness-of-fill contour map was prepared for Area D (Figure 3-1). The thickness of fill is based on visual descriptions of soil samples. Birdseye Street and Beacon Point Road are assumed to have been built prior to fill deposition based on historical aerial photographs, although portions of both roadways have been modified or extended during fill activities.

Fill was mapped in the study area by the Connecticut State Geological and Natural History, *Survey Surficial Geology of the Ansonia and Milford Quadrangles in 1968*. In this report fill is mapped only "where it is known or judged to be at least 5 feet thick" (Flint, 1968).

Fill consists of both natural and artificial materials placed as a result of human activity. Fill materials include manufacturing, household, and construction debris. This debris is mixed with natural materials such as silty sand and gravel. These artificial materials were generally present in a matrix of silty to gravelly sand, with varying amounts of silt and gravel. Other fill materials that do not contain visual evidence of man-made debris are present throughout Area III, generally consisting of sands with varying amounts of silt and gravel. This re-worked native fill is frequently more difficult to distinguish from natural/native non-disturbed deposits. The boring logs, located in Appendix A, contain detailed descriptions of the fill and natural soils. Identification of fill was done by visual descriptions of soil and sediment samples collected during the field investigation. The focus of this report is to identify fill that occurs within Area III. Roads that form the boundaries for Area D of Area III are included in the fill thickness map, as the fill thickness map only includes Area D (figure 3-1). Roads that are expected to contain some road-base material or fill were built before the filling activities occurred in the wetland areas (based on historical aerial photographs) that are the subject of this RI. No differentiation was made between Raymark soil-waste/fill and other types of fill on the fill thickness maps.

Area III overburden geology is discussed below. Area designations are described in Section 1.3.2 and shown on Figure 1-2.

Area D (Beacon Point Area)

The description of overburden geologic materials presented below is based on nine soil borings and ten sediment core samples. D-SB01 through D-SB09 were advanced in Area D to depths of 16 feet below grade by HNUS, as part of the 1997 Phase II Site Investigation (described in Section 2.7.1). During this same field investigation, D-SD01 through D-SD10 sediment cores were advanced to 4 feet bgs in the Area D wetlands. Boring and sediment core locations used to determine fill thickness are presented on Figure 3-1. Refer to Figure 4-1 for sample locations in Area D.

Fill was identified in each of the nine borings to depths exceeding 16 feet. Fill was found throughout the entire borehole at numerous locations in Area D. As noted by the greater than symbol on Figure 3-1 fill thickness exceeded 16 feet (the maximum investigation depth) at D-SB04, D-SB06, and D-SB07. While the northern portion of Area D was found to have the thickest fill, the depth of fill is unknown in the southern portion of Area D due to refusal on cobbles and slag debris at D-SB01. Fill thickness varies significantly from point to point as expected with large variations occurring over short horizontal distances. Fill was noted in three of the ten sediment core locations (D-SD03, D-SD-06, and D-SD07). Each of those three locations is inside and adjacent to the perimeter of the delineated wetlands. In Area D, the fill matrix was generally comprised of silt, organic silt, or silty sand. Artificial materials observed within the fill in Area D included slag, asbestos fibers, sludge/pigment, asphalt-like shingles, gasket material, glass, asphalt, charcoal, and concrete.

In most of the borings advanced in Area D, the fill materials are underlain by coastal wetlands deposits comprised of silt or organic silt with trace to some fine sand (i.e. D-SB05 and D-SB07). In the southern portion of Area D, at borings D-SB03, and D-SD03, sand, with varying amounts of gravel is more prevalent underlying the upper fill and silt or silty sand horizons.

Area E (Elm Street Wetlands)

Limited surficial geologic descriptions are available for Area E, which is comprised of wetlands. Several soil borings were advanced on residential properties in the vicinity of Area E to depths of up to 8 feet below grade. These borings indicate that shallow soils in the vicinity of the wetlands consist generally of surface topsoil underlain by silty sand and sandy silt (in places, with traces of debris, brick, concrete, glass, etc., termed "fill") up to a maximum of approximately 3 feet below grade. This horizon is generally underlain by organic-rich sandy or clayey silt or peat (up to approximately 6.5 to 7.0 feet) (Weston, 1995). All sample locations are shown on Figure 4-8. Boring logs and sediment sample logs are included in Appendix A.

No fill thickness maps have been produced for Area E.

3.3 Hydrogeology

Regional hydrogeologic units consist of unconsolidated overburden deposits, including till, stratified outwash, swamp and marsh deposits, and an upper fractured bedrock unit. Regional groundwater flow in OU3 area appears to be influenced by Ferry Creek and the Housatonic River. The wetland's hydrology and flow is generally toward the Housatonic River (HNUS, 1995).

Groundwater levels for Area III vary from approximately 8.0 feet to less than 1.0 feet bgs. These groundwater levels are based on estimated groundwater levels according to observations made in the field and recorded on the boring logs for Area III. Because no shallow overburden monitoring wells are present in Area III, definite water levels could not be measured. It appears that groundwater flow direction within the shallow overburden aquifer is south and southeasterly toward the surface water body, the Housatonic River and adjacent wetlands (HNUS, 1995). Groundwater does appear to be hydrologically connected to surface water bodies, resulting in groundwater discharge into the Housatonic River and adjacent wetlands. The surface water bodies are tidally influence as discussed in Section 3.4, Surface Water Hydrology. However, the extent of tidal influence on groundwater has not been investigated in this RI. Because none of the Area III borings were cored to bedrock, groundwater depth and flow through bedrock can not be assessed for Area III.

Groundwater in the vicinity of Area III is classified as GB (unsuitable for drinking without treatment) by the CT DEP. All drinking water for Area III is supplied by the Bridgeport Hydraulic Company. The supply source of public drinking water is Trapp Falls Reservoir located in Shelton, Connecticut, approximately 5 miles from the study area.

3.4 Surface Water Hydrology

The Area III is located in the Housatonic Main Stem Regional Drainage Basin. Long Island Sound receives the area's entire surface drainage via the Housatonic River. Large areas of wetlands are also included in Area III, as detailed in Section 1.3.2. Surface water enters Area D as either discharge from the POTW located due west of Beacon Point Road or as drainage from Area E via a swale north of Birdseye Street.

The Housatonic River and Area III wetlands are tidally influenced. The Housatonic is tidally influenced 11 miles upstream of the mouth of Ferry Creek, at the Derby Dam in Derby, Connecticut (Weston, 1993).

The Housatonic River is listed as Class SC/SB water (coastal and marine surface water that does not meet criteria for marine-life habitat, recreation, or industrial use), with an average discharge of 3,400 cubic feet per second at its mouth based on an average discharge (Weston, 1993).

Additional detailed hydrologic information on delineation of drainage areas for each area and elevations within each watershed area, discussion of storm drain networks, overland flow, tidal hydraulics, and rainfall runoff analysis is presented in Appendix C.

3.5 Climate and Meteorology

Area III is located in a temperate-humid climate, characterized by highly changeable weather and large daily and annual temperature variations. The most pronounced topographical effect is the land-sea breeze, an occurrence generally associated with the spring through early autumn months. Mean monthly temperatures during the summer average 3 to 5 degrees lower than nearby inland locations. Temperatures during the fall and winter months are moderated because of the proximity of Long Island Sound. Winter snowfall is generally around 10 inches less than areas a few miles inland, also due to the proximity of Long Island Sound.

Low lying areas are subject to flooding during periods of high tide. Tides 3 to 5 feet higher than normal may be encountered in the presence of slow-moving, deepening low pressure systems.

Area III is highly impacted by storm events, as the area is located within a storm surge zone. Hurricanes, gale storms, and rain storms frequently occur and contribute to the flooding events within Area III.

The NOAA Climatological Station is located at the Bridgeport-Sikorsky Airport, less than 1 mile from the southern-most commercial property (1 Beacon Point Road). For the past 30 years, data from this station have been used to describe the general climate in the area.

July is the warmest month with an average temperature of 73.4° F. The coldest month is January with an average temperature of 28.7° F. The maximum temperature observed between 1939-1998 was 103° F. The minimum temperature observed during this period was -7° F. Normal annual precipitation for the region is 42.6 inches, with between 3 and 4 inches of rain or water equivalent falling during each month. The area has an average annual snowfall of 25.8 inches, which generally occurs between November and April. Most snowfall occurs in January and February. Averages for these 2 months are 7.4 inches and 7.6 inches, respectively.

Wind speed in the region varies between 9.3 and 13.0 mph with an average of 11.4 mph. In the warmer months the prevailing wind direction is southwest. In the colder, months the prevailing direction is west to northwest.

4.0 NATURE AND EXTENT OF CONTAMINATION

This section presents a summary of the results of the chemical characterization conducted to support completion of the RI. A discussion of the potential sources of contamination affecting the entire OU3 study area (see Figures 1-1 and Figure 1-2) is provided in Section 4.1. Section 4.2 presents an overview of the types of chemical compounds detected, and a brief discussion relating the presence of these chemicals to past operations at the Raymark Facility. Section 4.3 provides a discussion of the background concentrations developed for comparison with the OU3 study area values. Summaries of the nature and extent of contamination for each portion of Area III are provided in Sections 4.4 and 4.5. Section 4.6 provides a discussion of the correlation among the contaminants of concern in sediments. Analytical data used to evaluate the nature and extent of contamination can be found in Appendix B. While the evaluation of the nature and extent of contamination includes discussions of the major classes of chemical contaminants analyzed, EPA directed that the RI focus on chemical characterization of the four major contaminants (copper, lead, PCBs, and asbestos) associated with past activities conducted at the Raymark Facility. In Area III, copper has not been a consistent indicator of contamination; therefore only figures depicting the presence and concentrations of lead, PCBs and asbestos are included to support the summaries in Sections 4.4 and 4.5.

4.1 Potential Sources of Contamination

A description of the potential sources of contamination affecting Area III associated with past operational and disposal practices of the Raymark Facility is presented below. The contamination sources include locations where Raymark soil-waste/fill materials were disposed of (dumped) at residential and commercial properties within or adjacent to Area III locations where erosion and/or leaching of the Raymark soil-waste/fill materials is occurring, former discharge of wastewater from the Raymark Facility to Ferry Creek, and discharge of contaminated groundwater to Ferry Creek and connecting waterways. Efforts to evaluate the groundwater as a potential contaminant source are being conducted as part of the OU2 Groundwater RI.

4.1.1 Raymark Soil-Waste/Fill Materials Disposal

As detailed in Section 1.3.1, lagoons were used at the former Raymark Facility to collect wastewater storm water drainage, and surface water runoff. Settled materials in the lagoons was periodically dredged and used as "fill" material both at the Raymark Facility and at various locations in Stratford. Sampling at some of these locations confirmed the presence of contaminants at levels designated a human health threat (based on EPA-established criteria).

The EPA and its contractors excavated and removed more than 60,000 cubic yards of Raymark soil-waste/fill material during time-critical removal actions at residential properties from 1993 to 1996. Approximately 30,000 cubic yards of Raymark soil-waste/fill material were also excavated and removed from the Wooster Middle School playing fields in 1995 by the CT DEP. All excavated areas were backfilled with clean fill. All excavated materials were transported to the Raymark Facility and placed under a RCRA type cap installed as part of the source control remedial action for the Raymark Facility. The Record of Decision (ROD) for this remedial action was signed July 3, 1995.

The excavation of Raymark soil-waste/fill under time-critical removal actions at residential properties located adjacent to wetland areas was terminated at the boundary of the wetland area. These excavations were terminated because of the presence of saturated wetland soils and vegetation marked the limits of the area where soils would present the greatest human health threat. Surficial wetland soil/sediment samples were collected at the termination point for use in future investigations of the area. These samples are included in the pertinent areas in this RI. (HNUS, 1995 and Ebasco, 1995). Those sampling locations included within the study area are discussed in further detail in Sections 4.4 and 4.5.

Additional field investigations and actions were completed in and around the Raymark Facility (see Section 2.0). Extensive sampling of commercial properties was conducted on properties where disposal of Raymark soil-waste/fill was suspected. Based on sampling results, properties with surface contamination were fenced and/or the waste areas covered (by pavement or wood chips) by the CT DEP. Commercial and adjacent properties with surface and subsurface contamination are the subject of this RI.

Raymark soil-waste/fill was deposited in Area D as well as the residential property adjacent to Area E. Erosion of these materials into proximate waterways (the Housatonic River) and the drainage swale along the northern edge of the Area E wetlands may have occurred, thereby transporting contaminants throughout Area D and Area E.

4.1.2 Raymark Wastewater Discharge

As discussed in Section 1.3.1, the majority of the Raymark Facility's wastewater was collected and discharged to a series of four settling lagoons, that in turn discharged directly into Ferry Creek (HNUS, 1995). These lagoons also received stormwater drainage and surface water runoff from the Raymark Facility. Primarily, the wastewater discharge affected areas along Ferry Creek and the Housatonic River and may have impacted Area D (See Figure 1-2). The contaminants identified in river sediments are similar to those identified at the Raymark Facility.

4.2 Overview of Chemicals Detected

Brief descriptions of the major classes of chemical contaminants detected in the sediment, surface water, soil, and biota in the OU3 study area, and the common industrial uses of these chemicals, are provided in Sections 4.2.1 through 4.2.7. Section 4.2.8 and Table 4-1 provide a summary of the specific chemicals known to have been stored, handled, and/or used at the former Raymark Facility during its operation that may have contributed to contamination of the OU3 study area. A discussion of the terminology used for evaluating the analytical data collected in the OU3 study area is provided in Section 4.2.9. An evaluation of the usability of field screening data collected to support the RI is included in Section 4.2.10.

4.2.1 Volatile Organic Compounds (VOCs)

The VOCs detected in environmental samples collected from the OU3 study area may be separated into three major groups: chlorinated hydrocarbons, aromatic hydrocarbons, and ketones. Many of these VOCs are organic solvents commonly used in industrial processes for degreasing parts; preparing metal surfaces prior to painting, coating, or bonding; thinning paints and resins; and extracting organic compounds from materials. Additionally, some of the detected VOCs are common constituents of gasoline and petroleum fuels.

VOCs detected in Area III and used at the Raymark Facility consisted mainly of chlorinated hydrocarbons, aromatic hydrocarbons, and ketones used as organic solvents.

4.2.2 Semivolatile Organic Compounds (SVOCs)

The SVOCs detected in environmental samples collected from the OU3 study area may be separated into three major groups: phenolic compounds, polynuclear aromatic hydrocarbons (PAHs), and phthalates. Other SVOCs detected include only a few isolated compounds. SVOCs are common constituents of various industrial products. Phenolic compounds are typically associated with fuels, coal, and petroleum products, and are used to manufacture friction materials. PAHs are common components of coal tar (bitumen and asphaltic tars), petroleum products (motor and fuel oil), and combustion by-products. Phthalates are typically used as plasticizers in the manufacture of synthetic materials.

SVOCs used at the former Raymark Facility included phenolic compounds, the PAH naphthalene, and phthalates. Phenolic resins were used in manufacturing friction materials.

4.2.3 Pesticides

Pesticides are typically used to control the presence or population of unwanted insects in both residential and commercial areas, as well as to prevent crop destruction in agricultural settings. Pesticide formulations may include chlorinated and organophosphorus varieties.

Pesticides were detected in Area III and may have been used at the Raymark Facility to control insect populations. However, no documentation of use has been identified.

4.2.4 Polychlorinated Biphenyls (PCBs)

The PCBs detected in the environmental samples collected from the OU3 study area consisted primarily of Aroclor 1262 and Aroclor 1268. PCBs are extremely stable chemicals with a wide range of physical properties. They have been historically used in plasticizers, adhesives, lubricants, heat transfer fluids, and as dielectric fluids in transformers and capacitors. Aroclor 1262 and Aroclor 1268, specifically, are commonly used as plasticizers in synthetic resins. Aroclor 1268 is also commonly used as a wax extender and plasticizer in rubbers.

No information has been provided directly by the Raymark Facility documenting the specific use of PCBs as part of their manufacturing process. However, the EPA has reported that PCBs were used in manufacturing brake linings. The Raymark Facility also used and/or manufactured both rubbers (gasket materials) and resins (phenolic resins in brake linings). Aroclor 1262 and Aroclor 1268 may have been used as plasticizers in these materials.

Aroclor 1262 and Aroclor 1268 were the only Aroclors detected in Raymark soils and groundwater. Although PCBs are used by many industries, the presence of Aroclor 1262 and Aroclor 1268 within the Stratford area appears to be unique to the Raymark Facility. Because of their widespread presence at the former Raymark Facility, and their absence from other industries that could have influenced the OU3 study area, these two PCBs can be attributed to Raymark soil-waste/fill.

4.2.5 Dioxins and Furans

Environmental samples from the OU3 study area contained detectable concentrations of dioxins and furans. Dioxins and furans are not manufactured commercially, but are formed during the production of chlorinated compounds (such as, PCBs, herbicides, pesticides, and chlorophenols), or as a result of incomplete combustion of chlorinated chemical compounds (such as PCBs). The term “dioxins” is commonly used to refer to a specific group of polychlorinated dibenzo-p-dioxin chemical compounds. The toxicity of one specific compound, 2,3,7,8-tetrachloro-dibenzo-p-dioxin (2,3,7,8-TCDD), has been studied more than other known dioxins and furans. The toxicity of all other dioxins and furans are expressed in relation to 2,3,7,8-TCDD, and are reported in terms of Toxic Equivalency (TEQ) concentrations.

4.2.6 Metals

Numerous metals were detected in the environmental samples collected from the OU3 study area. Metals are naturally occurring components of soil and/or localized mineral deposits, or are the result of decomposition of weathered bedrock. Metals may also be introduced into the environment through various industrial activities including disposal of waste materials or process sludges, and fugitive emissions from various thermal or combustion processes.

Barium, copper, lead, tin, and zinc were the primary metals used at the Raymark Facility to fabricate various brake and friction materials. Each (except tin which was not analyzed for) was detected at elevated concentrations in the study area.

4.2.7 Asbestos

Asbestos was detected in sediment and soil samples collected from the OU3 study area. Asbestos is a group of magnesium silicate minerals that contain varying quantities of iron and calcium silicates. Because of its non-combustible and heat-resistant properties, asbestos was commonly used to manufacture brake linings, gaskets, fireproof fabrics, roofing materials, and electrical and heat insulation, and as a reinforcing agent in rubber and plastics.

Asbestos-containing materials were a primary component in the products manufactured at the former Raymark Facility. Asbestos fibers were mixed with phenolic resins to manufacture brake pads and linings. Asbestos was also used to manufacture friction materials (clutches and automatic transmission plates) and gaskets. Chrysotile was the most common commercial form of asbestos used.

4.2.8 Chemical Compounds Used or Handled at the Raymark Facility

A number of chemical compounds and materials were handled, stored, and/or used in manufacturing processes at the Raymark Facility during its operation. A list of these chemicals, presented in Table 4-1, was developed from information provided in the *RCRA Facility Investigation Report* (ELI, 1995) and the RCRA Part A application (August 15, 1980). No

Part B application was ever filed for the facility; however, a draft application was developed by Raymark and not submitted.

4.2.9 Terminology for Evaluating Analytical Data

In order to evaluate the nature and extent of contamination in the OU3 study area, and determine its relationship to past disposal and operational practices at the Raymark Facility, data generated from analysis of field samples are typically compared to background concentrations and reviewed in relation to the data collected throughout an entire area of concern. Definitions of the terms used to describe and compare the contaminant concentrations in these subsequent sections are as follows:

- elevated - detected at a concentration either greater than its corresponding average background concentration, or greater than a specified concentration if no average background concentration was determined

- high, higher or highest - detected in one location at one or more orders of magnitude greater than at another location

- comparable - detected in one location at the same order of magnitude as another location

- low or lower - detected in one location at one or more orders of magnitude less than another location

Discussion about the development of background concentrations is provided in Section 4.3.

Definitions of terms related to sampling depths and media are as follows:

- Surface Samples – Samples collected at depths of up to 2.0 feet below ground surface (bgs).

- Subsurface Samples – Samples collected at depths of greater than 2.0 feet bgs.

- Sediment Samples – Samples collected in the Housatonic River, or within a delineated wetland or marsh area.

- Soil Samples – Samples collected outside of the Housatonic River, and outside a delineated wetland or marsh area.

4.2.10 Evaluation of Usability of Field Screening Data

During the Phase I RI conducted by TtNUS under Work Assignment 42-1LH3, Contract No. 68-W8-0117, soil samples were collected from various properties in the OU3 study area. To characterize the depth of Raymark soil-waste/fill in these areas, and to determine if the fill was associated with past disposal of Raymark soil-waste/fill, the samples were analyzed for asbestos and screened for lead, copper, and PCBs. A select number of these lead, copper, and PCB samples were also submitted for confirmatory analysis through EPA CLP.

The lead, copper, and PCB screening data were evaluated by statistical analyses (linear regression and Wilcoxon Rank-Sum nonparametric t-test) to determine a potential correlation between the screening data and the results of CLP analyses. The linear regression analysis involved a point-by-point comparison of the data generated by the two methods. The nonparametric t-test approach compared the means between the two data sets.

The results of the statistical analyses indicated that the screening data collected for copper and lead could be used with the same level of confidence as the CLP data for concentrations within the ranges of 300-1000 mg/kg and 100-4000 mg/kg, respectively. A poor correlation was found between the PCB screening and CLP data. EPA, therefore, deemed the copper and lead screening data acceptable for quantitative use in the RI and risk assessment; the PCB screening data were determined to be acceptable only for qualitative use (B&RE, 1997b and 1997c).

4.3 <u>Background Concentrations</u>

To assess whether chemicals (organic compounds and metals) detected in study area environmental media are related to or are the result of past disposal activities or releases, it is necessary to compare the analytical results for samples collected in the study area with those obtained from locations that are unlikely to have been affected by past site activities. In this way, chemical presence in the study area may be attributed to naturally occurring sources (such as metals in soils); contamination that is pervasive in an area, i.e., pesticides in agricultural communities, lead in urbanized areas, etc., or to site-related occurrences.

Because of variability in the analytical data and/or heterogeneity of the samples, average background concentrations were developed by averaging the numerical data from samples deemed representative of background conditions. (The numerical averages were calculated as the arithmetic average of the detected concentrations and half the detection limits for those compounds/analytes reported as undetected.)

For purposes of evaluating the nature and extent of contamination, the average background concentrations serve as a basis to identify elevated contaminant concentrations in samples collected within Area III (see Sections 4.4 and 4.5). If contaminant concentrations exceeded the average background concentrations, a contaminant source was suspected and the contaminant concentrations were considered "elevated." Because of the industrial nature of the Stratford area, contaminant concentrations below the average background levels are not considered representative of an affected area and, therefore, did not warrant further discussion in the evaluation of nature and extent. However, it is important to note for the human health risk assessment that background concentrations were not used to eliminate chemicals of potential concern (COPCs) except in the case of non-carcinogenic metals. Contaminants not analyzed in the background samples were compared to other soil/sediment screening values such as the Connecticut Pollutant Mobility Criteria (CT PMC) for GB Aquifers or the Connecticut Direct Exposure Criteria (CT DEC) for Residential Soils. Surface water results were compared to the Connecticut Ambient Water Quality (CT AWQ) criteria (human health criteria – water and organisms).

Sediment, surface water, and soil samples were collected throughout various locations of the town of Stratford. Based on the analytical results, specific locations were determined as representative samples of background conditions, and average background concentrations were calculated. The following subsections (4.3.1, 4.3.2, and 4.3.3) discuss background samples for sediment, surface water, and soil in more detail.

4.3.1 Sediment

Sediment samples were collected from Great Meadow (located in the southern portion of Stratford, along Long Island Sound and adjacent to the Bridgeport Municipal Airport) and Nell's Island (located on the eastern side of the Housatonic River in the Town of Milford). The samples were analyzed for VOCs, SVOCs, pesticides/PCBs, dioxins/furans, and metals. Following a review of the analytical data, four samples from four locations were determined to be representative of background conditions. Representative background sediment concentrations were developed by averaging the concentrations from these four samples. The average background concentrations for VOCs, SVOCs, pesticides/PCBs, dioxins/furans, and metals are presented in Table 4-2. Background sediment samples were not analyzed for asbestos.

4.3.2 Surface Water

Surface water samples were also collected from Great Meadow and Nell's Island. The samples were analyzed for VOCs, SVOCs, pesticides/PCBs, and metals. The analytical results of eight samples from eight locations, determined to be representative of background conditions, were averaged to develop the representative background surface water concentrations. The average background concentrations for VOCs, SVOCs, pesticides, PCBs, and metals are presented in Table 4-3. No SVOCs were detected in the background samples of surface water. Background surface water samples were not analyzed for dioxins/furans or asbestos.

4.3.3 Soil

Soil samples were collected from various locations around the Town of Stratford from schools, day care centers, and recreational areas. The samples were analyzed for pesticides and PCBs and metals. Metals results from 34 of 39 sample locations and pesticides and PCBs results from 27 of 37 sample locations were determined to be representative of background conditions. These values were averaged to develop the representative background soil concentrations. The average background concentrations for pesticides, PCBs, and metals are presented in Table 4-4. Background soil samples were not analyzed for VOCs, SVOCs, dioxins/furans, or asbestos.

Sections 4.4 to 4.6.2,
Section 5.0 and Section 6.0 to 6.4.3,
(pages 49 - 101)
are available
in a separate file (size: 4.7 MB)

Click here to view.

Sections 6.4.3.1 to 6.9.4,
(pages 102 - 155)
are available
in a separate file (size: 4.6 MB)

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Section 7.0, Section 8.0,
and References
(pages 156 - 200)
are available
in a separate file (size: 3.6 MB)

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